

NOTES ON THE OLDER TERTIARY FORAMINIFERAL  
ROCKS ON THE WEST COAST OF SANTO, NEW  
HEBRIDES.

BY FREDERICK CHAPMAN, A.L.S., F.R.M.S., NATIONAL MUSEUM,  
MELBOURNE.

(Communicated by Professor David.)

(With Plates v.-viii.)

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i. INTRODUCTION.

A short while ago I received some samples of rocks, collected in the New Hebrides, from Prof. T. Edgeworth David, of Sydney University. These rocks are chiefly limestones, and there was included a foraminiferal tuff.

Since the exact geological age of the Tertiary rocks in the New Hebrides is a matter of particular interest, I have, with the permission of the Director of the National Museum, dealt with them, at the request of Prof. David, in order to ascertain that fact. The specimens which form the subject of this paper were collected in the Island of Santo (Espiritu Santo) by Mr. Douglas Mawson, B.Sc., B.E., of Sydney University.

The more recent reef-rocks found at considerable elevations in the islands of this group have already been referred to by Dr. G. J. Hinde, in an Appendix to Lt. Frederick's paper "Geological

Notes on Certain Islands in the New Hebrides,"\* but no information is there given regarding the oldest limestones of the group.

On the west coast of the island of Santo, the oldest Tertiary limestones are found dipping at a steep angle, and are overlain with beds of tuff, soapstone and volcanic rocks. This older series, Prof. David informs me, is apparently divisible into two groups, marked by a slight unconformity. It is to the lower part of this series (group No 7 of Prof. David's list) that I have confined my observations, only dealing with such specimens as were found *in situ*, or which by their organic contents showed them to be of a similar age.

#### ii. DESCRIPTION OF THE ROCK SPECIMENS.

The localities referred to below are taken from the list accompanying the specimens, and printed between quotation marks.

For the main part I have relied on specimen No. 182 for the exact determination of species; and have at the same time made full use of the thin slices of the limestones prepared under Prof. David's direction, as well as several additional microscope slides and sections of selected foraminifera prepared by myself.

133.—“A pebble on small rise in the valley between Lobweri and Partua Tabua, Santo. Probably *in situ*.” A cut surface of the hand specimen is of a purplish or dull plum colour. This rock may be termed a *Lepidocyclina* Limestone. Its structure is somewhat brecciated, and it is largely composed of tests of Foraminifera (*Lepidocyclina*) and branchlets of the calcareous alga, *Lithothamnion*. The interstitial structure of the rock, as seen in thin sections, is partly crystalline and partly organic, formed by the cementation of comminuted shell-fragments by calcite; some crystals of augite and fragments of a basic lava also occur in parts of the slide. Amongst the coarser organic contents of the rock, plates and spines of echinoids were seen.

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\* Quart. Journ. Geol. Soc., Vol. xlix., 1893, pp.230, 231.

The Foraminifera contained in this specimen are as follows :—  
*Globigerina* sp. (cf. *G. bulloides*, d'Orb., or *G. rosacea*, d'Orb.).  
*Carpenteria* sp.

? *Polystomella*, or a related nummulinoid form, the peripheral edge showing the "marginal cord."

*Lepidocyclina insulæ-natalis*, Jones & Chapm.

„ „ var. *inequalis*, Jones & Chapm.

134.—"From the top of the N.W. spur of Partua Tabua, on the track 1500 ft. above sea-level, Santo."

A dark greyish Nullipore Limestone with *Lepidocyclina*. In thin sections this rock is seen to consist of organic material as foraminiferal fragments of the cœnosteum of (?) *Millepora* tests, (*Lepidocyclina* and *Heterostegina*), *Lithothamnion*, both encrusting and branching forms very abundant (one encrusting example showing conceptacles), together with fragments of an andesitic rock. The interspaces between the coarser organic and fragmentary constituents are filled with a fine calcareous mud, and in places they are cemented by crystalline calcite.

The Foraminifera are :—

? *Planorbulina* (encrusting).

? *Truncatulina* (of the *lobatula* type).

*Miogypsina burdigalensis*, Gümbel sp.

„ ? *globulina*, Michelotti sp.

*Heterostegina* cf. *margaritata*, Schlumberger.

*Cycloclypeus* sp.

*Lepidocyclina* cf. *martini*, Schlumberger.

„ ? *insulæ-natalis*, Jones & Chapm.

176.—"Limestone outcrop on Wai Malikoliko near where the track descends to the river, Santo. Beds dipping 70°."

A dense cream-coloured limestone.

In thin sections this rock is seen to consist chiefly of the tests of *Lepidocyclina* and fragments of branching and encrusting *Lithothamnion*, together with occasional pieces of molluscan shells, often (?) alga-bored, plates and spines of echinoids, coral and milleporid fragments. The organisms in this limestone are

very well preserved, the interspaces being filled in with calcareous mud, and often further cemented by crystalline calcite. The Foraminifera are as follows :—

*Miliolina* sp.

*Carpenteria* sp. (somewhat crushed); common.

*Polytrema planum*, Carter (encrusting masses of *Lithothamnion*).

*Amphistegina lessoni*, d'Orb.; frequent.

*Heterostegina* cf. *margaritata*, Schlumb.; frequent.

*Cycloclypens* sp. (fragmentary); fairly common.

*Lepidocyclina martini*, Schlumb.

178.—“Shaley beds from Wai Malikoliko, same locality as 176, Santo.”

A detrital limestone with variable structure. The rock-section shows several layers bedded upon one another. The coarser portion of the rock is a fragmental organic limestone containing a few (?) andesitic particles. The only organic remains which can be recognised in this portion of the rock are, besides foraminiferal tests, *Lithothamnion* (branching form) and a few shell-fragments. The Foraminifera in this coarser portion are :—

*Bolivina* cf. *textularioides*, Reuss.

*Globigerina* cf. *bulloides*, or *G. rosacea*, d'Orb.; numerous.

? *Carpenteria* (fragments).

*Lepidocyclina* sp.

The finer layers in this slide consist of an impure calcareous mud, with well-marked lines of sedimentation. There are numerous transparent particles, evidently organic, but too fragmentary to be recognisable, with the exception of an occasional test of *Globigerina*.

182.—“Decomposed friable rock just below the limestone at Wai Malikoliko.”

This is an ochreous-coloured tuff containing numerous Foraminifera, chiefly of the genus *Lepidocyclina*. An Ostracod (*Bairdia*) and a fragment of an echinoid spine were also seen. The Foraminifera are more or less corroded, and only the larger forms, as a rule, seem to be left. The Foraminifera obtained

from this rock specimen by breaking up and washing are of very great interest. The following were found :—

*Gaudryina subrotundata*, Schwager; one specimen.

*Bolivina nobilis*, Hantken; one specimen.

*Globigerina bulloides*, d'Orb.; one specimen.

*Spheroidina bulloides*, d'Orb.; occasional.

*Discorbina* (?) *biconcava*, Parker & Jones; one specimen.

„ *bertheloti*, d'Orb. sp.; one specimen.

*Truncatulina ungeriana*, d'Orb. sp.; one specimen.

*Carpenteria proteiformis*, Goës; one specimen.

*Miogypsina irregularis*, Michelotti sp.; frequent.

„ *burdigalensis*, Gümbel sp.; several specimens.

„ *complanata*, Schlumberger; rare.

*Pulvinulina* sp.; one specimen.

*Amphistegina lessoni*, d'Orb.; common.

*Heterostegina depressa*, d'Orb.; frequent.

„ *margaritata*, Schlumb.; common.

*Cycloclypeus pustulosus*, sp.nov.; common.

*Lepidocyclina martini*, Schlumb.; very common.

„ „ „ var. *rotula*, nov.; rare.

190.—“Stratified sedimentary rocks 25 feet above sea-level, south of Saurii, Santo.”

The two samples of rock, marked A and B, are very dark in colour and resemble in appearance an indurated ash.

Slide A.—Under the microscope this rock is seen to consist of a fine-grained calcareous mud largely of organic origin, and to a great extent intermixed with fine particles of volcanic products, as in No. 178.

The only recognisable organisms seem to belong to *Globigerina bulloides*, d'Orb.

Slide B.—A fragmental organic limestone with numerous lava particles and crystals.

The organic fragments comprise *Lithothamnion* (branching form), foraminifera, echinoid spines and molluscan shell-fragments. The Foraminifera are as follows :—

? *Truncatulina*.

*Carpenteria* sp.

*Lepidocyclina* aff. *insule-natalis*, Jones & Chapm.

199.—“ Lower portion of sedimentary beds, C. Karai, Santo.”

A volcanic tuff with a few organic particles. The rock is largely composed of pyroxenic and other minerals.

One test of a foraminifer, apparently referable to *Globigerina conglobata*, Brady, was noticed.

208.—“ Older sedimentary beds (dipping 55°) of the Wai Bubo, Santo.”

A fine-grained calcareous and tufaceous mud, with occasional tests of a starved *Globigerina* (aff. *bulloides*, d'Orb.).

210.—“ Older sedimentaries of the Wai Bubo at the farthest point reached, Santo.”

A brecciated limestone, chiefly organic, but intermixed with crystals and fragments of igneous rocks.

The following organisms, badly preserved, were recognised :—

*Lithothamnion* (branching form).

*Heterostegina* sp. (fragmentary); numerous.

? *Lepidocyclina*.

211c.—“ Limestone pebbles, in tuff dipping 55°, Wai Bubo, Santo.”

A compact grey or greenish limestone. The microscopic structure is seen to be largely that of a foraminiferal limestone; the organic material is admixed with some andesitic fragments, and minerals such as felspar, and altered ferro-magnesian silicates. The cement of the rock is in parts a tufaceous mud, in other places a crystalline cement. Besides foraminifera (of which there is in this rock a great variety) there are numerous examples of *Lithothamnion*, both branching and encrusting, echinoid spines and plates, and molluscan shell-fragments. The structure of the

organisms has been well preserved in this limestone. The Foraminifera are as follows :—

- Miliolina* cf. *seminulum*, Linn. sp.  
 „ cf. *oblonga*, Mont. sp.  
 „ cf. *subrotunda*, Mont. sp.  
*Textularia* cf. *gramen*, d'Orb.  
*Globigerina bulloides*, d'Orb.; common.  
*Truncatulina refulgens*, Montf. sp.  
*Carpenteria* sp.  
*Miogypsina neodispansa*, Jones & Chapm. sp.  
*Amphistegina lessoni*, d'Orb.  
*Heterostegina margaritata*, Schlumb.  
*Lepidocyclus insulæ-natalis*, Jones & Chapm.  
 „ „ var. *inequalis*, Jones & Chapm.  
 „ (?) *sumatrensis*, Brady.

212.—“Tuff with calcareous fragments interbedded with the sedimentaries dipping 55°. Wai Bubo, Santo.”

A tufaceous limestone. In hand specimens it is of a dark blue-grey colour, showing on the fractured surfaces angular fragments of a decomposed (greenish) andesitic rock.

The microscopical examination of this rock shows it to be largely made up of organic fragments such as are seen in a typical consolidated coral-sand, but with the addition of chips of igneous rocks and numerous felspar crystals. The cement appears to be formed of a fine brownish volcanic ash.

The calcareous particles consist of the cœnenchyma of corals, *Lithothamnion*, and spines of echinoids. The following Foraminifera were also met with :—

- Textularia* sp.  
*Globigerina bulloides*, d'Orb.  
*Carpenteria* sp.  
*Amphistegina lessoni*, d'Orb.  
*Lepidocyclus insulæ-natalis*, Jones & Chapm.  
 „ cf. *martini*, Schlumb.

223.—“Older sedimentary rocks 25 ft. thick and dipping 50°, on the Wai Bubo, Santo.”

A compact dark grey limestone largely composed of *Lithothamnion* and *Lepidocyclina*. Besides the above, the following organic remains are present: numerous other Foraminiferal echinoid spines, and lamellibranch shells. The Foraminifera are:—

*Miliolina* sp. (a triloculine form).

*Textularia rugosa*, Reuss.

*Globigerina bulloides*, d'Orb.

*Sphaeroidina bulloides*, d'Orb.

*Truncatulina* sp.

*Anomalina* sp.

*Polytrema planum*, Carter.

*Amphistegina lessoni*, d'Orb.; common.

*Operculina complanata*, Defr.

*Heterostegina* sp.

*Cyclochypus pustulosus*, sp.nov.

*Lepidocyclina* (?) *sumatrensis*, Brady.

„ *martini*, Schlumberger.

„ *andrewsiana*, Jones & Chapm.

„ *insule-natalis*, Jones & Chapm.

### iii. DISTRIBUTION LIST OF THE FORAMINIFERA, WITH NOTES ON THE NEW AND RARE FORMS.

*Miliolina* spp.; Nos. 176, 223.

*M.* cf. *seminulum*, Linn. sp.; No. 211.

*M.* cf. *oblonga*, Mont. sp.; No. 211.

*M.* cf. *subrotunda*, Mont. sp.; No. 211. [Our example agrees in cross-section with this form, which is commonly found in littoral sands, and is also a familiar Miocene fossil].

*Textularia rugosa*, Reuss sp.; No. 223. [A well-known coral-reef species and found fossil in strata as old as Oligocene].

*T.* cf. *gramen*, d'Orb.; No. 211. [But for the fact that there are thin-shelled examples they might be considered to belong to the preceding species].



*T.* sp.; No. 212.

*Gaudryina subrotundata*, Schwager; No. 182. [This species is already described from the Miocene; and has been obtained in recent dredgings from Torres Straits and the West Indies].

*Bolivina* cf. *textilarioides*, Reuss; No. 178.

*B. nobilis*, Hantken; No. 182. [The fossil specimens were obtained by von Hantken from the "Clavulina-szabói" beds of Ofen, Hungary. At the present day its distribution is confined to the Pacific].

*Globigerina bulloides*, d'Orb.; Nos. 182, 190, 211, 212, 223.

„ cf. *bulloides*, d'Orb.; Nos. 133, 178, 208.

[The thin-shelled variety of *G. bulloides*, indicating a somewhat turbid marine condition, is fairly common in these rocks].

*G. conglobata*, Brady; No. 199.

*Sphaeroidina bulloides*, d'Orb.; Nos. 182, 223,

*Discorbina* (?) *biconcava*, Parker and Jones; No. 182. [A slightly aberrant form of what is probably the above-named species. *D. biconcava*, as a living foraminifer, seemed to be confined to the seas around Australia until Mr. Siddall discovered the same form in the estuary of the Dee, represented by minute but otherwise typical examples].

*D. bertheloti*, d'Orb.; No. 182.

? *Planorbulina*; No. 134. [An encrusting form].

*Truncatulina ungeriana*, d'Orb.; No. 182.

*T.* cf. *lobatula*, Walker & Jacob sp.; No. 134.

*T. refulgens*, Montfort sp.; No. 211.

*T.* sp.; No. 223.

? *Truncatulina*.; No. 190.

*Anomalina* sp.; No. 223.

*Carpenteria proteiformis*, Goës; No. 182. [A fragment of a cylindrical test showing several chambers, the acervuline character of the latter agreeing with some varieties remarked upon by the late Dr. H. B. Brady.\* In our specimen the perforations are filled up and stained of a dark colour].

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\* Rep. Chall. Vol. ix. 1884, p.679.

*Carpenteria* sp.; No. 133. [Fragments of a wild-growing form like *C. raphidodendron*, Moebius, sp. It also shows a resemblance to *C. capitata*, Jones & Chapm.\*

*Carpenteria* (fragments); Nos. 176, (?) 178, 190, 211, 212.

*Pulvinulina* sp.; No. 182.

*Miogypsina burdigalensis*, Gümbel, sp.; Nos. 134, 182. [Not uncommon].

*M.* (?) *globulina*, Mich. sp.; No. 134.

*M. irregularis*, Mich. sp.; No. 182. [Not uncommon].

*M. complanata*, Schlumberger; No. 182. [Rare].

*M. neodispansa*, Jones & Chapm. sp.; No. 211. [Under the name of *Orbitoides* (*Lepidocyclina*) *neodispansa* this form was first described from the Miocene limestones of Christmas Island. It properly belongs to the genus *Miogypsina*, however, since the median series of chamberlets is arranged in a spiral; the latter feature was not shown in the thin slides made from the Christmas Island rocks.† In its general form *M. neodispansa* approaches that of *M. burdigalensis*, Gümbel, sp., but differs in having the vertical pillars of the outer series much less pronounced].‡

*Polytremma planum*, Carter; Nos. 176, 223. [This important encrusting reef-organism was also met with in some abundance, associated with *Lepidocyclinae*, in the limestones of Christmas Island;§ before this occurrence it had been found only as a living species. It is interesting, therefore, to meet with it again in the fossil condition].

? *Polystomella*; No. 133. [Section of a nummulinoid form showing peripheral edge with the "marginal cord"].

\* Mon. of Christmas Is. (Brit. Mus. Nat. Hist.) 1900, p.246, pl.xx. f.7.

† *Op. cit.* p.235, pl.xx. figs.3, 4.

‡ See Schlumberger, 'Note sur le genre *Miogypsina*.' Bull. Soc. Géol. France, Sér. 3, Vol.xxviii. p.330, pl.ii. figs.11, 12, pl.iii. figs.22-25. I have, since writing the above, seen a note by Lemoine & Douvillé referring to this form as *Miogypsina* (?). Mém. Soc. Géol. Fr. 1904, Vol.xii. fasc.ii. Mém.32, p. 35.—F.C., July, '05.

§ Recorded under the name of *Polytremma miniacum* var. *involuta*. *Op. supra cit.* p.255, etc.

- Amphistegina lessoni*, d'Orb.; Nos. 176, 182, 211, 212, 223.  
 [Usually the small, compressed, lenticular variety].  
*Operculina complanata*, DeFrance; No. 223.  
*Heterostegina depressa*, d'Orb.; No. 182.  
*H. margaritata*, Schlumberger\*; Nos. 182, 211.  
*H. cf. margaritata*; Nos. 134, 176.  
*H. sp.*; Nos. 210, 223.  
*Cycloclypeus sp.*; Nos. 134, 176, 223.

## C. PUSTULOSUS, sp.nov.

(Plate v. fig.1; pl.vi. fig.2; pl.vii. fig.2).

[Description.—This species is readily separable from already known forms by its closely pimpled shell-surface. This decoration is not confined to the central area of the test as in the megalospheric form of *C. carpenteri* (Brady's *C. guembelianus*), but is uniformly distributed over the whole surface. In the present form the chamberlets are, generally speaking, more rectangular than those of *C. carpenteri*, and towards the periphery become very narrow. A fine example, in median section, of a microspheric form, is shown on pl.vi. fig.2. Diameter of test 1 to 6 mm.; Nos. 182, 223].

*Cycloclypeus sp.*; Nos. 134, 176.*Lepidocyclina insulæ-natalis*, Jones & Chapm.; Nos. 133, (?) 134, (?) 190, 211, 212, 223.

*L. insulæ-natalis* var. *inequalis*, Jones & Chapm.; Nos. 133, 211. [The *Lepidocyclina* described by Prof. Rupert Jones and myself from the Miocene limestones of Christmas Island under the name of *L. insulæ-natalis*† represented the microspheric condition. The megalospheric individuals may possibly be represented by the so-called variety *inequalis*,‡ which is closely comparable, if not identical with *L. murrayana*, Jones & Chapm.,§

\* Samml. Geol. Reichs-Mus. Leiden, Ser. 1. Vol. vi. pt. 3, 1902, p. 252, pl. vii. fig. 4.

† Mon. of Christmas Island (Brit. Mus. Nat. Hist.) 1900, p. 242, pl. xx. fig. 5, pl. xxi. figs. 13, 14.

‡ *Op. cit.* pp. 254, 255, pl. xxi. fig. 12.

§ *Op. cit.* pp. 252, 253, pl. xxi. fig. 10.

and *L. formosa*, Schlumberger.\* The characters shown by thin slices of the tests in the rocks before us, as, for example, in the saddle-like form, in the 4-rayed aspect in median section due to twisting in process of growth, and in the invariable accompaniment of a megalosphere, together with its association with shells of *L. insule-natalis*, lend support to this view]

*L. martini*, Schlumberger;† Nos. 176, 182, 223.

*L. MARTINI*, var. *ROTULA*, nov.; No. 182.

(Plate vii. fig. 4).

[Description. — Some examples, probably of the megalospheric form, of an almost globular shape, with short regular peripheral processes were met with. At first sight they seemed suggestive of a form of *Tinoporos*, but thin sections showed them to be related to the above species.]

*L. cf. martini*; Nos. 134, 212.

*Lepidocyclina* sp.; No. 178.

? *Lepidocyclina*; No. 210.

*Lepidocyclina* (?) *sumatrensis*, Brady; Nos. 211, 223.

*L. andreusiana*, Jones & Chapm.; No. 223.

#### IV. NOTE ON THE OSTRACOD.

*BAIRDIA cf. FOVEOLATA*, G. S. Brady.

*Bairdia foveolata*, G. S. Brady, 1880, Rep. Chall. Zool. pt. iii. p. 55, pl. viii., figs 1 a-f.

*Id.*, 1890, Trans. R. Soc. Edinb. Vol. xxxv. p. 493.

Chapman, 1902, Journ. Linn. Soc. Zool. Vol. xxviii. p. 423.

The present example, which occurred in sample No. 182, is a left valve of a form of *Bairdia* most like the above species. In outline, this valve is exactly comparable with *B. foveolata*, more especially with certain specimens I have already obtained from

\* Samml. des Geol. Reichs-Mus. Leiden, Ser. 1. Vol. vi. pt. 3, 1902, pp. 251-2, pl. vii. figs. 1-3.

† Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Vol. vi. pt. 3, 1900, p. 131 pl. vi. figs. 5, 8.

shallow water sands of the coral islets at Funafuti. The ornamentation of this valve is not very clear, as it appears to have been corroded over the anterior portion of the outer surface. What may be indications of a pitted surface are visible in one or two places. *B. foveolata* is a characteristic and often common form in the Southern Seas, and it has occurred as far south as Bass Strait.

#### V. SUMMARY OF RESULTS.

The foregoing examination of the oldest sedimentary rocks seen and collected by Mr. Mawson in the Island of Santo proves them to be of Miocene age (Aquitanian and Burdigalian).

A point of particular interest brought out by the present investigations is the association of *Lepidocyclina* with the excentric forms of *Miogyssina* in the New Hebrides. According to H. Douvillé,\* the latter make their appearance after the *Lepidocyclina* in the Miocene of the South-west of France; although the regular form, *M. burdigalensis*, is contemporaneous with that genus in beds of Aquitanian age (basal beds of Miocene). The next stage in ascending order, the Burdigalian, is in the same area characterized by *Miogyssina globulina*, *M. irregularis* and *M. complanata*.

In the Miocene rocks of Santo, however, both the excentric and the regular forms occur in the same deposit, namely, the foraminiferal tufaceous rock underlying the massive *Lepidocyclina* limestone at Wai Malikoliko. From this we naturally infer that faunas, distinct in the European area, were living together in the New Hebrides Miocene sea.

A similar association of species occurs here as in the Miocene limestones of Christmas Island, and also of Madoura, and other parts of the Dutch East Indies, with which the New Hebrides marine area was most probably connected when these fossiliferous beach and shallow-water deposits were laid down.

The occurrence of a new species of *Cycloclypeus* in the New Hebrides rocks further emphasises the fact that certain genera

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\* Bull. Soc. Géol. France, Sér. 4, Vol. ii. 1902, p. 312.

and species of even such lowly forms as protozoa have been more or less restricted in their geographical distribution from their earliest geological appearance until recent times; for this part of the world afforded us the earliest dredged specimens of *Cycloclypeus*, and with the exception of an Arabian fossil species, the Tertiary examples seem to be restricted to this area also.

NOTE.—Since writing the above (Aug., 1904), I have received from Messrs. P. Lemoine & R. Douvillé an interesting and important monograph on the genus *Lepidocyclina* (Mém. Soc. Géol. France, Vol.xii. fasc.ii. Mém.32, 1904).

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EXPLANATION OF PLATES V.-VIII.

Plate v.

Fig. 1.—Foraminiferal limestone, with *Cycloclypeus*, *Lithothamnion* and echinoid spines ( $\times 16$ ).

No. 223. The Bubo, Santo.

Fig. 2.—Foraminiferal limestone, with *Lepidocyclina martini*, Schlumberger, and *Polytrema planum*, Carter ( $\times 16$ ).

No. 176. Wai Malikoliko, Santo.

Plate vi.

Fig. 1.—*Lepidocyclina insulæ-natalis*, Jones & Chapm. Section across the median plane ( $\times 16$ ).

No. 211a. Wai Bubo, Santo.

Fig. 2.—*Cycloclypeus pustulosus*, sp.nov. Section through the median plane of a microspheric form ( $\times 16$ ).

No. 182. Wai Malikoliko, Santo.

Plate vii.

Fig. 1.—*Bairdia* sp. cf. *foreolata*, G. S. Brady. A left valve ( $\times 32$ ). From the decomposed, friable rock just below the limestone at Wai Malikoliko (No. 182).

Fig. 2.—*Cycloclypeus pustulosus*, sp.nov. ( $\times 32$ ). Wai Malikoliko (No.182).

Fig. 3.—*Lepidocyclina martini*, Schlumberger, var. *rotula*, nov. ( $\times 16$ ). Wai Malikoliko (No. 182).

Fig. 4.—*L. martini*, var. *rotula*, nov. Section through the test, partly median, partly tangential ( $\times 32$ ). Wai Malikoliko (No. 182).

Plate viii.

Generalised Geological Section across South Santo. By D. Mawson.